DETAILS OF THE WEATHER IN THE UNITED STATES

GENERAL CONDITIONS

By ALFRED J. HENRY

The outstanding feature of the month was the mild temperatures experienced in practically all parts of the country (Chart IV). Naturally there was an absence of general cold waves. This condition was probably due, in great part, to the presence of great barometric depressions centered over the Gulf of Alaska and the northeastern Pacific from which offshoots were discharged at fairly regular intervals throughout the month. There was also an unusual number of secondary cyclonic disturbances which for the most part originated east of the Rocky Mountains in southeastern Wyoming. Some of these moved toward the southeast and then to the northeast and two of them had a short life. Pressure in the North Pacific HIGH was but 30.18 inches; the North Atlantic HIGH was however, well developed on both sides of that ocean. The usual details follow.

CYCLONES AND ANTICYCLONES

By W. P. DAY

The month began with a series of LOWS passing through the Aleutian Islands, the Gulf of Alaska, British Columbia, and along the northern border, a condition continuing until the 9th, when rising pressure over the interior of Alaska and the Canadian Northwest caused a deflection of the LOWS into lower latitudes. The latter condition continued until the end of the month, with generally high pressure over the interior of Canada and a succession of high-pressure areas from that region. However, these moving HIGHS, with the exception of the one which appeared over Alberta on the 25th, did not produce any marked changes to colder. With one or two exceptions the low-pressure areas passing across the United States were not important as storms, but their great frequency associated with the numerous HIGHS caused rapid fluctuations in temperature in north-central districts during the second and third decades of the month.

FREE-AIR SUMMARY

By V. E. JAKL

Free-air temperatures were above normal over all aerological stations, and the departures moreover were generally quite uniform with altitude. (See Table 1). Therefore Chart III, this REVIEW, giving surface departures, represents the free-air departures as well. Pronounced inversion in temperature were not so frequent as in the preceding winter months, yet a few instances of decided inversion were recorded during the first few days. The kite flights at Ellendale furnished an example on the 2d of an inversion that, for steepness of the inverted gradient, probably exceeds, or at any rate equals, any heretofore recorded at that station. On this date, the morning surface-minimum temperature was $-28.9°$ C.; at 900 meters above the ground the temperature at 8 a. m. was 0.4° C., and at 3,900 meters above the ground the temperature at 9:30 a. m. was $-13.1°$ C. The circumstance of pressure, wind direction, etc., inducing this temperature gradient was typical of the conditions attending recovery of temperature after a cold wave, as brought out in the Free-Air Summary for January, 1925.

It was shown in the Free-Air Summary for December, 1924, that cold waves were often observed to begin in the lower levels and then gradually extend to higher altitudes, the building-up process sometimes taking a number of days. On the other hand, the change to colder sometimes seems to occur almost simultaneously above and below, and again a change to decidedly colder aloft may be accompanied by no change or a retarded change in the levels near the ground. Illustrations of a few of the diverse vertical temperature gradients accompanying changes to colder are given in the following extracts from the records of Broken Arrow, and Ellendale, in which each column shows the temperature in the free air after a change to colder from the day before. At Broken Arrow the change on the 2d was most pronounced in the lower levels, and on the 25th in the upper levels, and similarly at Ellendale on the 1st and 26th respectively.

Broken Arrow, Okla. (altitude, 233 meters, m. s. l.)

Feb. 2, 1925			Feb. 25, 1925		
Altitude, m. s. l. (meters)	Temperature	Wind direction	Altitude, m. s. l. (meters)	Temperature	Wind direction
	° C.			° C.	
Surface	−8.0	N.	Surface	6.7	NNW.
668	−11.8	NNE.	519	8.6	NNE.
1,152	2.9	NNE.	975	8.4	N.
3,308	−7.5	NNE.	2,161	−2.7	NNW.
3,807	−4.5	NNE.	2,913	−10.6	NNW.
4,302	−7.6	N.	3,636	−16.4	NW.

Ellendale, N. Dak. (altitude, 444 meters, m. s. l.)

Feb. 1, 1925			Feb. 26, 1925		
Altitude, m. s. l. (meters)	Temperature	Wind direction	Altitude, m. s. l. (meters)	Temperature	Wind direction
	° C.			° C.	
Surface	−22.6	N.	Surface	−21.2	NW.
669	−24.9	N.	1,159	−26.8	NW.
1,817	−17.9	NNW.	1,777	−22.7	NNW.
2,474	−7.9	NW.	2,404	−21.0	NNW.
			2,821	−22.5	NNW.

It is of interest to note to what extent these different types of temperature changes are distinguished by definite types of weather maps. As an approach to an approximate classification, it may be said that when a HIGH is being gradually reinforced, the "building up" process continues until the isobars are closed on the north, after which a change to warmer undoubtedly begins—probably in the upper levels first. If a "closed" HIGH passes over a station, it is a common fact of observation that the lowest temperature will not extend above some moderate altitude, say 1,000 to 2,000 meters. If a well-defined LOW with long isobars in its rear extending far to the north precedes the HIGH, there will be a strong drainage from a northerly direction to a great depth and over considerable territory, and the change to colder will occur simultaneously aloft and below, or more rapidly aloft than below, according to the various characteristics of the HIGH and the position of the place of observation relative to the pressure trough and crest. As the identity of these different types is of course not always well defined, a clue to the vertical temperature gradient may sometimes be had by considering the probable sources of air at the different levels, in connection with the various pressure and temperature features of the surface weather map.

Wind resultants for the month, deduced from kite and pilot-balloon observations, showed a fairly close agreement with the normal, i. e., winds of moderate force varying somewhat between south and west near the ground, but tending steadily to become strong winds from nearly due west in the higher levels. (See Table 2). However, a slight deviation of the resultant wind from normal (less northerly component in the upper levels and more southerly component in the lower levels) is noted over most stations. This slight deviation does not appear sufficient to account for the general well defined excess of the mean temperature over the normal. This may be ascribed to the comparative infrequency of severe cold waves during the month, and the fact that a rigid comparison between resultant wind directions and mean temperatures is not warranted. The force of this last statement is apparent when it is considered that sometimes a south wind is cold, particularly in the lower levels, when it occurs in the receding phase of cold waves, and that a northwest wind is sometimes warm, particularly in the upper levels, when it occurs in connection with a LOW advancing from the Northwest, and may perhaps be traced back to oceanic origin.

A number of instances of high wind occurred during the last decade, in connection with the passage of well-defined LOWS over the country. Examples of such winds are given in the observations at Ellendale and Memphis on the 26th, of 36 meters per second from the northwest at 4,000 meters altitude, and 35 meters per second from the west-southwest at 2,500 meters altitude, respectively; and at Royal Center on the 27th, of 35 meters per second from the west-northwest at 3,400 meters. In these instances, however, a strong latitudinal temperature gradient undoubtedly contributed toward the observed velocities, inasmuch as in each case cited the observation was made at a time when the station was outside the immediate scope of the low pressure area appearing on the surface map. Instances of high velocity aloft, where the latitudinal temperature gradient seemed to be the predominant factor, occurred frequently toward the end of the middle decade. Examples are taken from the records of the 17th, on which date at Ellendale the wind showed a steady rapid rise from 3 meters per second on the ground to 30 meters per second at 3,800 meters altitude, and at Royal Center a wind of 1 meter per second on the ground gained strength with altitude to 5,200 meters, where a velocity of 34 meters per second was recorded.

The average relative humidity and vapor pressure for the month showed no important differences from the normal at any station. In the records of individual observations some significant features of humidity are shown, of which examples are given in the following table of the observations at Broken Arrow and Groesbeck on the 22d and 28th, respectively. These observations illustrate the effectiveness of source of air in changing the humidity at any particular level.

Broken Arrow, Okla. (altitude, 233 meters), February 22, 1925

Time	Altitude, m. s. l. (meters)	Temperature	Relative humidity	Wind direction
		° *C.*	*Per cent*	
7:57 a. m.	Surface	13.0	97	S.
8:36 a. m.	1,553	9.6	58	SSW.
9:17 a. m.	2,425	−0.4	91	SSW.
10:02 a. m.	2,470	1.0	34	W.
10:16 a. m.	1,328	11.8	57	SSW.
13:45 a. m.	Surface	16.0	79	S.

Groesbeck, Tex. (altitude, 141 meters), February 28, 1925

Time	Altitude, m. s. l. (meters)	Temperature	Relative humidity	Wind direction
		° *C.*	*Per cent*	
2:09 p. m.	Surface	14.5	62	SSW.
2:33 p. m.	1,119	8.1	92	S.
2:54 p. m.	1,942	6.7	21	SW.
4:09 p. m.	4,450	−4.0	12	WSW.
4:59 p. m.	2,177	5.6	12	WSW.
5:21 p. m.	1,047	13.6	16	S.
5:34 p. m.	Surface	16.8	59	SSW.

It will be noted that at Broken Arrow between 2,400 and 2,500 meters the temperature rose and humidity fell, attending a change in direction from south to west from 9:17 a. m. to 10:02 a. m. As the change in humidity is much too large to be accounted for by a mere change in temperature due to adiabatic or insolation causes, the change must necessarily have been of an advectional nature. Similarly, at Groesbeck the change at about 1,100 meters from 92 per cent at 2:33 p. m. to 16 per cent at 5:21 p. m. can be accounted for in no other way, as the accompanying rise in temperature was inadequate of itself to cause the observed fall in humidity. The record of Groesbeck, moreover, proves that such rapid changes in humidity are not necessarily brought about by changes in wind direction, as the wind remained due south at the level in question throughout the observation.

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during February, 1925*

TEMPERATURE (°C)

Altitude, m. s. l. (*m.*)	Broken Arrow, Okla. (233 *m.*)		Drexel, Nebr. (396 *m.*)		Due West, S. C. (217 *m.*)		Ellendale, N. Dak. (444 *m.*)		Groesbeck, Tex. (141 *m.*)		Royal Center, Ind. (225 *m.*)	
	Mean	Departure from 7-yr. mean	Mean	Departure from 10-yr. mean	Mean	Departure from 4-yr. mean	Mean	Departure from 8-yr. mean	Mean	Departure from 7-yr. mean	Mean	Departure from 7-yr. mean
Surface	5.5	+0.4	−2.0	+1.9	8.9	+0.4	−7.6	+2.5	13.1	+2.9	0.9	+2.7
250	5.5	+0.5			8.7	+0.4			12.6	+2.8	0.7	+2.7
500	5.0	+1.3	−2.1	+2.2	7.1	+0.2	−7.7	+2.4	11.7	+2.9	−0.9	+2.9
750	4.6	+1.8	−1.5	+3.1	6.4	+0.4	−7.7	+2.0	11.5	+3.0	−1.5	+3.0
1,000	4.9	+2.4	0.3	+4.2	5.5	+0.2	−6.9	+2.2	11.5	+3.2	−1.5	+3.3
1,250	4.7	+2.4	0.8	+4.1	4.6	+0.2	−6.4	+2.2	10.8	+3.1	−1.9	+3.4
1,500	4.3	+2.6	0.4	+3.8	3.7	+0.2	−6.4	+2.1	10.0	+3.0	−2.4	+3.3
2,000	1.9	+1.7	−1.5	+3.1	1.4	−0.5	−7.2	+2.5	7.6	+2.5	−3.9	+2.9
2,500	−1.0	+1.1	−3.9	+2.8	−0.7	−0.1	−9.9	+1.9	5.0	+2.2	−6.4	+2.1
3,000	−4.3	+0.5	−6.8	+2.4	−2.7	+0.1	−12.8	+1.6	2.3	+1.9	−9.4	+1.5
3,500	−7.3	+0.1	−9.6	+2.3	−5.8	−0.2	−15.8	+1.3	−0.8	+1.3	−13.2	+0.5
4,000	−9.9	+0.1	−13.4	+1.4	−7.7	+0.8	−18.6	+1.1	−3.6	+0.9	−17.8	−1.0
4,500	−13.4	−0.3	−16.6	+1.4			−21.5	+0.9				
5,000			−19.8	+1.8			−24.5	+0.8				

RELATIVE HUMIDITY (%)

Surface	70	+3	79	+2	67	−1	81	0	64	−10	78	0
250	70	+3			66	−2			63	−9	78	0
500	64	0	76	+1	62	−3	80	0	61	−8	77	−1
750	58	−3	66	−4	59	−5	75	+1	55	−10	74	−1
1,000	50	−6	55	−9	56	−7	69	−1	47	−13	68	−2
1,250	44	−8	50	−10	54	−8	65	−1	43	−14	62	−4
1,500	42	−8	48	−9	53	−7	62	0	39	−14	57	−5
2,000	37	−9	48	−5	53	−4	58	−1	35	−13	55	−2
2,500	36	−9	48	−4	49	−7	58	−1	36	−9	55	0
3,000	36	−6	50	−2	46	−7	58	0	37	−7	59	+3
3,500	37	−4	50	−2	50	−3	55	−1	38	−4	65	+8
4,000	36	−5	49	−1	74	+13	55	0	38	0	82	+23
4,500	38	−3	49	−1			57	+2				
5,000			46	−4			60	+2				

VAPOR PRESSURE (*mb.*)

Surface	6.65	+0.50	4.37	+0.56	8.15	+0.06	3.07	+0.51	9.97	+0.28	5.61	+1.17
250	6.59	+0.49			7.97	+0.01			9.54	+0.31	5.53	+1.16
500	5.65	+0.28	4.17	+0.55	6.73	−0.38	3.03	+0.51	8.71	+0.42	5.02	+1.17
750	4.98	+0.24	3.73	+0.45	6.08	−0.54	2.75	+0.40	7.72	+0.15	4.69	+1.19
1,000	4.34	+0.09	3.32	+0.23	5.54	−0.73	2.67	+0.38	6.45	−0.35	4.19	+0.99
1,250	3.71	−0.13	3.08	+0.13	4.91	−0.87	2.62	+0.40	5.63	−0.49	3.65	+0.81
1,500	3.36	−0.12	2.91	+0.17	4.45	−0.83	2.50	+0.42	4.78	−0.54	3.19	+0.66
2,000	2.49	−0.29	2.50	+0.19	3.70	−0.56	2.13	+0.37	3.74	−0.35	2.46	+0.43
2,500	1.96	−0.35	2.15	+0.23	2.94	−0.51	1.72	+0.25	3.26	−0.05	1.74	+0.07
3,000	1.58	−0.26	1.83	+0.25	2.48	+0.27	1.30	+0.16	2.86	+0.05	1.39	+0.03
3,500	1.29	−0.19	1.50	+0.23	2.20	−0.18	0.95	+0.09	2.54	+0.21	0.95	−0.07
4,000	1.09	−0.09	1.18	+0.21	2.69	+0.53	0.67	−0.01	2.47	+0.61	0.82	+0.07
4,500	0.88	−0.03	1.03	+0.22			0.51	−0.03				
5,000			0.89	+0.16			0.37	−0.02				

TABLE 2.—*Free-air resultant winds (m. p. s.) during February, 1925*

Altitude, m. s. l. (*m.*)	Broken Arrow, Okla. (233 *m.*)				Drexel, Nebr. (396 *m.*)				Due West, S. C. (217 *m.*)				Ellendale, N. Dak. (444 *m.*)				Groesbeck, Tex. (141 *m.*)				Royal Center, Ind. (225 *m.*)			
	Mean		7-year mean		Mean		10-year mean		Mean		4-year mean		Mean		8-year mean		Mean		7-year mean		Mean		7-year mean	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface	S. 81° E.	0.9	N. 20° W.	0.6	S. 55° W.	0.7	N. 67° W.	1.3	S. 81° W.	1.5	S. 89° W.	1.6	N. 43° W.	3.1	N. 43° W.	3.6	S. 36° W.	3.2	N. 76° W.	0.4	S. 50° W.	1.7	S. 81° W.	2.0
250	S. 74° E.	0.9	N. 24° W.	0.5	----	----	----	----	S. 83° W.	1.4	N. 89° W.	1.7	----	----	----	----	S. 40° W.	3.7	S. 68° W.	0.5	S. 50° W.	2.0	S. 77° W.	2.3
500	S. 17° E.	1.7	S. 85° W.	0.5	S. 63° W.	1.3	N. 74° W.	1.9	S. 80° W.	2.7	S. 87° W.	3.0	N. 49° W.	3.3	N. 48° W.	3.8	S. 42° W.	4.6	S. 42° W.	1.3	S. 48° W.	5.1	S. 66° W.	3.8
750	S. 41° W.	2.1	S. 63° W.	1.6	S. 84° W.	2.9	N. 71° W.	4.0	S. 79° W.	2.9	S. 80° W.	4.2	N. 61° W.	4.0	N. 55° W.	4.7	S. 53° W.	5.0	S. 51° W.	2.1	S. 58° W.	6.9	S. 68° W.	5.5
1,000	S. 70° W.	1.9	S. 70° W.	2.4	N. 83° W.	4.1	N. 66° W.	5.1	S. 86° W.	3.6	S. 80° W.	5.3	N. 64° W.	5.0	N. 43° W.	5.2	S. 63° W.	5.5	S. 63° W.	3.3	S. 65° W.	8.1	S. 73° W.	6.8
1,250	S. 82° W.	3.1	N. 88° W.	3.5	N. 84° W.	5.3	N. 66° W.	6.5	S. 84° W.	4.6	S. 81° W.	6.7	N. 68° W.	6.3	N. 55° W.	6.3	S. 77° W.	5.8	S. 74° W.	4.3	S. 67° W.	8.6	S. 81° W.	7.8
1,500	N. 85° W.	3.9	N. 81° W.	4.3	N. 78° W.	6.1	N. 66° W.	8.1	S. 88° W.	6.4	S. 84° W.	8.6	N. 71° W.	7.2	N. 59° W.	7.4	S. 84° W.	6.4	S. 80° W.	5.7	S. 75° W.	10.3	S. 86° W.	9.3
2,000	N. 86° W.	6.4	N. 77° W.	6.5	N. 81° W.	10.0	N. 69° W.	10.4	S. 84° W.	8.7	S. 86° W.	11.9	N. 68° W.	10.6	N. 62° W.	9.6	N. 85° W.	6.6	S. 86° W.	7.3	S. 77° W.	13.2	S. 89° W.	11.3
2,500	N. 88° W.	7.4	N. 76° W.	7.4	N. 87° W.	12.8	N. 70° W.	12.7	S. 67° W.	8.4	S. 83° W.	13.4	N. 67° W.	12.4	N. 64° W.	11.7	S. 76° W.	8.2	S. 88° W.	8.5	S. 64° W.	16.2	W.	13.7
3,000	N. 72° W.	6.5	N. 78° W.	9.7	N. 87° W.	14.3	N. 75° W.	14.4	S. 74° W.	10.2	S. 85° W.	15.4	N. 73° W.	13.7	N. 66° W.	13.0	S. 72° W.	9.8	S. 87° W.	10.4	S. 60° W.	17.3	S. 89° W.	14.6
3,500	N. 66° W.	10.0	N. 65° W.	10.7	N. 87° W.	15.4	N. 74° W.	15.8	N. 64° W.	10.3	N. 82° W.	16.3	N. 70° W.	15.4	N. 69° W.	12.9	S. 75° W.	10.6	N. 89° W.	11.2	S. 63° W.	17.0	N. 88° W.	17.2
4,000	N. 84° W.	12.5	N. 69° W.	10.7	S. 81° W.	16.1	N. 80° W.	15.9	N. 66° W.	12.0	N. 85° W.	11.6	N. 70° W.	17.1	N. 66° W.	14.1	S. 57° W.	17.2	N. 89° W.	12.3	S. 38° W.	17.7	S. 88° W.	16.2
4,500	S. 86° W.	12.5	N. 61° W.	11.9	S. 89° W.	21.5	N. 84° W.	17.6	----	----	----	----	N. 75° W.	20.2	N. 66° W.	15.4	S. 67° W.	18.0	N. 79° W.	12.8	S. 45° W.	20.9	W.	16.9
5,000	S. 87° W.	13.4	S. 74° W.	12.1	W.	20.0	N. 83° W.	16.8	----	----	----	----	N. 45° W.	17.0	N. 87° W.	17.2	----	----	----	----	----	----	----	----

THE WEATHER ELEMENTS

By P. C. DAY, In Charge of Division

PRESSURE AND WINDS

The first few days of February, 1925, brought important pressure variations and consequently sharp changes in temperature, particularly along the northern boundary and over the southern districts of Canada, where locally the lowest and highest temperatures of the month were recorded within 24 hours, the changes amounting to as much as 60° within the same period.

Immediately following, however, pressure assumed a more stable condition and weather changes were less marked until the beginning of the second decade, when cyclonic conditions overspread the districts from the Mississippi River eastward, attended by considerable rain or snow. This was immediately followed by an anticyclone which, though not producing marked low temperatures over northern districts, nevertheless favored an extension of freezing temperatures into the Southeastern States and notably over the Florida Peninsula, where on the 12th and 13th they occurred over the greater part of the State, though they continued for too short a period to cause serious damage save to the more tender forms of vegetation.

During the latter half of the month no important cyclones or anticyclones crossed the country until early in the last decade, when a cyclonic area that first appeared over the far southwest on the 21st attained considerable proportions by the morning of the 23d. At this time it covered an extensive area from the middle Mississippi Valley northeastward to the lower Lakes, and precipitation, mostly rain, had occurred over a wide area from the Great Plains eastward to the Appalachian Mountains, with local heavy falls in portions of the Mississippi and Ohio Valleys. During the following 24 hours the storm moved rapidly northeastward, attended by rains over most eastern districts, though the falls were mainly unimportant.

During the last few days of the month a cyclonic area moved eastward along the northern border from Montana to New England, becoming of considerable importance over the Great Lakes and thence to New England on the 26th and 27th. The precipitation attending this storm was mostly in the form of snow, some heavy falls being reported on the Canadian side of the border. High winds accompanied this storm from the lower lakes eastward to the coast, and considerably colder weather with high barometric pressure followed.

Anticyclones were mainly of far less importance than those usually experienced during a winter month. Those materially influencing the temperature over considerable areas were as follows: From the 1st to 3d, along the northern border from the Rocky Mountains eastward, that of the 11th to 13th bringing decidedly cold weather over the Southeastern States; and another near the end of the month that brought sharp falls in temperature from the northern Rocky Mountains eastward to New England.

In the far Western States moderate cyclonic conditions persisted during the first decade but were principally confined to the more northern districts. The second decade was comparatively free from storms of any character. The first half of the third decade had moderately unsettled, stormy weather over the northern districts, but the closing days were under the influence of an anticyclone of material strength.

The pressure distribution for the month as a whole was distinctly favorable for warm and dry conditions in most parts of the country. The barometric gradient was mainly toward the north, the anticyclones tending toward the southern section, while the cyclones frequently moved eastward along the northern boundary.

The average pressure was well below normal over all parts of the country save over the southwest and extreme northeast sections, and it was distinctly below in the central and far northwestern districts, thus favoring prevailing southerly winds over the greater part of the country. These were particularly noticeable in the western districts, where, on account of local topography, there is usually great diversity in the directions of the prevailing winds, while during the month under discussion they were remarkably constant from southerly points.

High winds were infrequent, and over the Atlantic coast districts and the Great Lakes they were mainly confined to the cyclone of the 26th and 27th. No important areas over the interior and southern portions of the country were affected by high winds, and some stations reported the lowest wind movement of record for February.

TEMPERATURE

The chief feature of the weather for February, 1925, is the uniformly high temperature that prevailed over all portions of the United States, and Canada also, as far as observations disclose.

An examination of the temperature data for February during the past 50 years does not disclose a single case where the monthly means of temperature were above normal for all portions of both countries, the reference to Canada of course covering only the southern portions, as no weather-reporting stations with records now available are located in other parts of that country.

The nearest approach to the conditions that existed during February, 1925, was in 1921, when February mean temperatures were above normal in all parts of the United